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ABSTRACT

This project developed 46 units of science activities suitable for individual use outside of school by elementary school children (K-6) with supervision by an adult advisor. Focusing on the physical, biological, earth, and health sciences, experimental work, and science processes, the materials (obtained at home or in supermarkets) are designed to complement classroom science programs or to be used on an individual basis for enrichment. Each unit consists of a child's and advisor's guide. The child's guide provides a brief introduction to the subject, suggested experimental investigations, and questions. The advisor's guide provides more detailed background information and suggestions for helping the child carry out the study. Although materials may be used by individuals independent of a school, they are designed for distribution by a teacher. In this mode children are invited to participate voluntarily. An evening parents' meeting is held by the teacher to explain the rationale of the activity and to conduct a workshop on the forthcoming unit. Parents attending are given advisor's guides and investigations are sent home for children, who are encouraged to keep lab books, and periodically report their progress in school, providing added learning in communication skills and mathematics. (Author/JN)

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FINAL REPORT

The Family Science Project

Family Oriented Science Study for Elementary School Children

NSF GRANT SED77-18034

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Final Report

The Family Science Project

The objective of this project was to develop science materials suitable for individual use by an elementary school age child and an adult advisor, who usually would be the child's parent. These materials would be used outside of school and would thus complement the science activities carried on in the classroom. In order to accomplish this aim efforts were focussed in the following areas:

1. Evaluation of existing science materials to determine their suitability for utilization in the context of this project.
2. Development of written materials for use by children, parents and teachers.
3. Testing, evaluation and modification of the materials developed.

Much of our initial effort was devoted to evaluation of existing science materials in order to determine if they would be suitable for adaption and utilization in the format envisioned for this project. We believed that our activities should all include hands-on experiments which "work" in the sense that a child would obtain a positive result which was sufficiently striking to make a lasting impression. We wanted each activity to accomplish several purposes. These included teaching basic laws of nature, teaching the processes of science and strengthening the home atmosphere for learning in general. The subject matter was to cover all fields of science. It is very important that a person embarking on the study of science recognize that nature itself is a unified and beautiful whole, not something which is broken into dozens

of unrelated and specialized aspects. The increasing compartmentalization which occurs as one progresses up through the educational system can easily give a student the wrong impression of how the cosmos functions.

A secondary objective for this work was to use the science activities as a vehicle for improving communication skills, both in writing and speaking, and mathematical ability.

In organizing the materials we were faced with the question of choosing a hierarchical format as opposed to developing independent units. The hierarchical structure has the advantage that it allows one skill or concept to build on another. However, it is also valuable to a parent or teacher to have modules which can be utilized without having completed prerequisite activities. Since we envisioned that our materials would be supplemental to the regular science program in the classroom, and since they might be used by parents intermittently, we chose to write materials that are relatively independent of each other. They do, however, vary in sophistication, ranging from kindergarten to sixth grade level.

Our initial efforts were devoted almost entirely to evaluating existing materials. We sought activities which could be carried on outside the classroom by young children with adults acting as advisors. We reviewed many books and articles and most of the major curriculum projects. Overall the results were disappointing. In many cases we found the experiments simply did not work with the level of equipment and expertise which could reasonably be expected of children and

untrained parents. We gained the strong impression that many of the proposed experiments had never in fact actually been carried out by the author. In writing our own materials we went to great efforts to make sure that our suggestions were realistic. We were careful to check out all of the experimental work under conditions likely to be encountered by a typical child. Experiments which give negative results, or which yield unclear or ambiguous data, are part of the real world of science, but they can be very discouraging to young people who are just beginning to study science. We have made a concerted effort to insure that the experiments will work out approximately as envisioned.

The materials we have developed are grouped into five groups: physical science, biological science, earth science, health science and processes of science. Each unit consists of two parts. The first is a child's guide which gives a brief introduction to the subject to be investigated and suggests a number of experiments. Some provocative questions are included. The child is encouraged to keep a lab notebook, to make graphs, to make repeated measurements, and to write narrative accounts. The second part of each unit is an advisor's guide. This is utilized by the parent in supervising the child's work. It includes more detailed background on the subject, rationale for the project, and answers to questions which are likely to arise. It also has suggestions for building apparatus and improvising experimental set-ups. All of the activities are designed to be carried out using materials readily available at home or in the neighborhood supermarket. Further, the cost of the materials needed is less than one dollar for almost

all of the units. The advisor's guide is printed on paper of a different color than that used for the children's guides.

Originally we intended to develop a separate teacher's guide, but we found that the parents wanted all of the material available to the teacher, so we ended up writing a single guide for use by both parent and teacher.

The primary mode of utilization for the materials of The Family Science Project is as follows: An elementary teacher chooses a unit which parallels or complements a science subject being studied at school. Children are invited to participate voluntarily. This is a "gifted and talented" program which is open to all comers. A note is sent home informing the parent of the activity and inviting participation. A one hour parents' meeting is held by the teacher. At this evening workshop the teacher explains the objectives of the activity and either demonstrates the experiment or provides materials so that the parents can try some of the steps for themselves. Parents have an opportunity to ask questions and to become acquainted. At the meeting they are given a copy of the advisor's guide to take home. The adults are advised that the children are to carry out the science activities over the next two to four weeks. The role and use of a laboratory notebook is explained. The parents are told that the children will have opportunities to report on their progress in class, and at the end of the investigation participants may share with the class their results and display apparatus built and used. We encourage teachers to provide a hallway display for appropriate units so that the whole school

can partake of the activities. Some of the units are suitable for science fair type displays as well.

Overall we believe that the curriculum development aspects of the program were very successful. We were able to develop many more units than envisioned in our original proposal. This phase of the work was very satisfying. Evaluation and testing proved less so. During the summers we invited small selected groups of children to test the various units as we went along, and this worked out well. However, testing the materials in actual classroom situations presented some difficulties. The school districts with whom we originally planned to work were continually embroiled in personnel negotiation conflicts during the evaluation and testing period. As a result, school administrators were reluctant to engage in any activity which they felt might be viewed by teachers as an assignment of extra duties. The superintendents were particularly dubious about being able to hold monthly evening parent meetings. It is our belief that such monthly parent-teacher meetings would greatly improve relations between the schools and the patrons who support them with their taxes, but both teachers and administrators expressed doubts about the benefits to be gained. Two superintendents stated that they did not want parental involvement in the education process, since they feared that participation in an activity such as the Family Science Project could open the door to lay involvement in other curriculum areas. In particular, there has been considerable furor in this region over the teaching of evolution versus the "creationist" theory and over sex education, and the administrators

were very wary of any innovation which would increase parental involvement. They would agree informally that parental involvement in education was a potential asset, but they were reluctant to take any chances. Generally speaking, school administrators do not see science education at the elementary level as having very high priority. This view is widely held by elementary teachers who for the most part see their mission as limited to teaching the three R's.

The materials were tested by approximately 200 students in kindergarten, third, fifth and sixth grades in the Moscow, Idaho, school district. Sixty fifth grade students did health activities in class and as "home work". The two teachers using the materials modified the format from that which we recommended in order to fit what they saw as their individual needs. They did not make use of evening parent meetings, partly because of reservations about having the parents attempt to tell them how science should be taught in their classrooms. The teachers were also reluctant to devote evening time to their jobs.

One sixth grade teacher used some of the units for independent study projects for six students, and the assessment by both the teacher and the students was favorable.

One hundred and twenty third grade students in four classes used some of the materials. Overall there was 65 percent parental participation in the evening meetings. Additional children whose parents did not attend the evening meetings participated. More mothers than fathers attended the meetings, but more fathers helped the students at home with the projects. There was significant involvement of siblings when the activities were carried out at home. Parents had a wide spectrum

of views about the program. A few liked it very much and a few disliked the idea. Many were neutral in that they would participate if this was expected of their children, but if the program were not offered they would not object. As a result of conversations with parents involved we found that most were primarily concerned with their children's ability to read and spell, and exposure to science did not seem of any great importance to them. They did not seem particularly concerned that there is very little science teaching in elementary schools, and this view was also held by the teachers with whom we worked.

We found that most activities were carried out hurriedly at home just before the "culmination day" when results and apparatus were to be brought to school. Botany units were not as successful as those in physical science, for example, because they generally required long range planning and execution.

There did not appear to be marked difference in accomplishment between those students whose parents attended the evening meetings and those who simply took the advisor's guide home to their parents.

Overall there was a somewhat negative attitude on the part of the teachers to evening meetings and to parent meetings in general. We originally hoped that the evening meetings would provide a forum where the teachers would be able to inform parents about school activities not only in science, but in other areas as well. Unfortunately the teachers saw the evening meetings as a source of anxiety. They felt they had to straighten up the room, put up new bulletin boards, and

generally clean house to prepare for company. Also, the teachers had a lot of insecurity about teaching science, and they were not keen on appearing before a group of parents to talk about the subject, even though we assured them that they need not be expert in the subject to utilize the materials. It turns out that you don't have to be expert to teach the processes of science, but it helps to have the confidence of an expert.

We hoped that one of the fringe benefits of The Family Science Project would be continuing science education for the parents participating. This indeed seemed to be the case, but several of the teachers did not react favorably to this aspect. They felt they were being paid to teach children, not adults.

A frequently expressed desire among the teachers was to have a well-organized, highly structured science curriculum, essentially "cookbook science". They were not appreciative of the need for experimentation and individual innovation. They favored curriculum materials which required minimum teacher preparation. The need to have gone through the unit beforehand was a major drawback in the eyes of many of the teachers. They felt they simply did not have the time. This, coupled with a lack of interest and motivation, is probably true. It would appear that some additional teacher training program would be needed before these materials could be effectively implemented in the public schools.

The teachers we approached displayed a disappointing lack of professionalism as far as carrying out their job was concerned. They were

opposed to evening meetings and any outside preparation time, since they felt they would not be paid extra for such work once the NSF project was ended. They also did not like the idea of running off duplicates of the units to be used at school. It was our intent that each teacher would have a master copy of The Family Science Project, and selected modules could be duplicated at school as needed. This would have major advantages to the school district in terms of costs, but it would involve some additional teacher work.

One teacher expressed the view that the program would not save any teacher time, but would merely rearrange it. She felt that a teacher who was not devoting much classroom time to science teaching would not devote the time needed to successfully use a home based curriculum. She also expressed concern about the lack of academic quality control inherent in a home program.

Participating parents were provided a questionnaire concerning the project, and it is appended along with a tabulation of responses. Approximately 50 percent of the families returned the questionnaires. A small fraction of the people were very enthusiastic about having their children participate in home science activities. Numerous individuals wrote to us from all over the country asking for copies of the materials for use by their own children, and many of these people reacted very favorably to them. A sample unsolicited letter is appended.

We contacted twenty publishing firms concerning dissemination of the materials developed. For the most part the comments we received back were very laudatory, but there was reluctance to publish such

material because of the concern about being able to make enough money from such a venture. Our intent in producing a master copy which could be cheaply duplicated in the schools is quite contrary to the desires of the publishing houses. They seem uniformly to push hard cover, large volume texts which will be required of each individual student. Several companies said that they were developing in house materials similar to ours and designed to accompany their hard back texts. One company, ENRICH, Inc., has asked us to write some science books for them, but they did not feel they could capitalize on the materials developed on the project.

The project received fairly wide publicity in newspapers, on television and on radio. We participated in an evening "talk show" in Detroit in which the project and NSF's efforts were discussed. We received inquiries from individuals and institutions interested in the materials. Complete copies of The Family Science Project were sent to each.

We encountered some management problems in carrying out this project which are perhaps not uncommon. One staff member, a zoology professor, who participated the first summer was unable to contribute effectively. The materials he developed were unsuitable for use by young children and parents. His difficulties stressed the importance of having had some practical experience teaching young children when writing curriculum materials. Scientific knowledge alone is not adequate.

We also suffered from a lack of administrative support within the Department of Physics and in the College of Letters and Science at the

University. It is difficult to do work in science education in a physics department. Physics professors are expected to do "hard physics", and education departments are resentful of people trespassing on their turf. It is one thing to work in science education at a prestigious school like Harvard or Berkeley, but it is quite a different matter at a middle level institution like Idaho. In sharp contrast to the attitudes of some local administrators were the actions of the NSF staff in the DISE program. They were without exception helpful and supportive. The directors' meetings were very valuable, as were the site visits by program managers. It is unfortunate that the Foundation travel budget does not allow for more such visits, particularly to remote areas like Idaho.

In view of what we have learned, it may be that a better vehicle could be found for implementing The Family Science Project. It seems unlikely that teachers will devote much extra effort to science teaching. It is possible that workshops could be held for those interested in improving their science programs, but this is not likely to affect a large fraction of all elementary teachers. It is also possible that video tapes could be prepared which would substitute for the evening parent-teacher meetings. These could be shown on public television for the benefit of parents who wished to have their children engage in an enrichment program in science. Alternately, such tapes could be made available at public libraries with facilities for utilizing such resources. Finally, the materials could be marketed commercially through book stores for purchase by individual parents who wished to help their children.

Our overall feelings about the project are as follows: The work we have done has not diminished our belief that parents are a valuable resource for teaching science. The materials developed are suitable for use by children outside school with adult supervision. We are satisfied with the quality of the units we have written. Their implementation in the schools in the manner we originally envisioned has some serious drawbacks. The principal obstacle seems to be the attitude and training of the elementary school teachers. For the most part it seems fair to say that they are generally disinterested in science. They lack confidence (perhaps justly so) in their ability to teach science, and they do not see science education at the elementary level as important. This reflects the kind of education they have received, and the attitudes of the education professors they knew in college. To some extent this lack of interest in science education for young children appears in the views of most of the parents with whom we worked. It thus appears that there is a general malaise towards science among the populace as a whole that transcends any immediate problems we faced in this project. Unless the value system of the citizenry and the education establishment is altered, it is unlikely that science education will flourish in the near future in this country.

Two copies of The Family Science Project and two copies of the NSF Form 98A are included with this report.

Snopake

Summary of Parental Responses
117 of 200 questionnaires returned

FAMILY SCIENCE PROJECT

Parent Questionnaire

1. Approximately how much time did you and your child spend on each activity package?

82 1) 0-2hours
29 2) 3-5 hours
9 3) 6-8 hours
4) more than 8 hours

2. Who usually initiated the activity sessions?

47 1) parent
70 2) child

3. How frequently did you and your child work on the the science projects?

1) Every day-- non-regular time
2) Every day- regular scedule
88 3) Two or more times per week--non-regular schedule
12 4) Two or more times per week--regular schedule
17 5) occasionally
6) other(explain)

4. Did the activities hold your child's interest?

71 1) yes
35 2) no
11 3) no opinion

5. Would you want your child and you to participate in a science project similar to this one next year?

58 1) yes
47 2) no
12 3) undecided

6. Would you want a program such as "Family Science Project" to be a regular part of your child's elementary school education?

58 1) yes
47 2) no
12 undecided

7. COMMENTS